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Manganese (Mn)

Mn is a necessary element for a range of plant, animal and microbiological functions i.e. photosynthesis in plants, nitrogen metabolism and assimilation in plants and microorganisms, and the development and function of the reproductive system, maintaining healthy nervous system, structural protein synthesis, energy production, health of joints and proper bone formation in animals. Manganese has an important role in many plant enzyme systems where it activates the enzyme by acting like a bridge, connecting the enzyme to the substrate upon which it is designed to act. Mn also plays a key role in seed quality and vitality.

In NZ conditions, Mn availability is rarely a problem and therefore, it is not usually necessary to add Mn to fertiliser mixes. On the contrary, problems are more likely to arise when Mn availability becomes too high. On soils less than pH 6.3 (which includes most NZ soils), manganese uptake is usually more than adequate for plant growth. Deficiencies can arise however, in dry alkaline soils. Adequate soil Mn levels also help control high molybdenum levels. However, low sulphur levels reduce the availability of Mn.

There are two main situations where there is potential for manganese toxicity - very acid soils and very wet soils (where either water logging is a problem or irrigation has been excessive). In both these situations, Mn availability increases rapidly because Mn is transformed from its normal oxidised Mn^{4+} state to its reduced and highly soluble form, Mn^{2+}. In drier conditions and neutral to alkaline pH, Mn typically occurs in its oxidised state as a reasonably insoluble compound. In this respect Mn is similar to Fe, which also occurs in its oxidised Fe^{3+} state in dry and alkaline conditions but as highly soluble and available Fe^{2+} in wet or acidic conditions. This highlights the importance of having a well aerated and well drained soil, with good structure and porosity. When a soil is well aerated with lots of pore spaces, oxygen levels are good and the potential for toxicity problems, such as just discussed, is reduced. Conversely, where oxygen levels are low, elements like Mn are transformed to their highly soluble reduced states, where they can often reach levels in the soil solution which are too toxic for plant roots. Occasionally, if a soil is poorly drained but also contains high levels of organic matter (eg peat, marsh land), interaction with organic compounds can cause a Mn deficiency.

In summary, Mn availability in the soil, and thus to plants via their roots, is largely determined by the interaction of soil acidity and aeration. Provided pH > 5.5 and soils are not water logged, Mn toxicity should not be a problem.